WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005CO118G

Title: Development of Characterization Approaches and a Management Tool for the Groundwater-Surface Water System in the Vicinity of Sutherland Reservoir and Gerald Gentlemen Station, Lincoln County, Nebraska

Project Type: Research

Focus Categories: Water Quantity, Groundwater, Models

Keywords: groundwater management characterization inversion parameter-estimation data-needs-assessment

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Congressional District: Colorado 7th

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Abstract

Conflict even between our own competing needs for water (e.g. water for a power plant to generate electricity to run an irrigation pump and water for irrigation) indicates our need for improved management approaches. Effective use of data is essential to resolving this problem. Generally, we, as a society, have not fully tapped the information in available data because of difficulties associated with its integration. The global problem addressed by the proposed research is improving hydrologic system characterization to reduce predictive uncertainty associated with ground water management problems through an iterative process that couples development of alternative conceptual models and data needs assessment. The specific problem to be used as a platform for developing this type of approach is water management in the vicinity of Sutherland Reservoir and the Gerald Gentlemen Station power plant, which overlies the High Plains (formerly Ogallala) Aquifer in Lincoln County, Nebraska.

Sutherland Reservoir must be maintained at or above a specific minimum level in order to provide sufficient cooling water to Gerald Gentleman Power Station. The reservoir leaks substantial, although unknown, volumes of water such that a large ground water mound provides domestic and irrigation water to the surrounding residents. Recent drought conditions threaten the supply to maintain that level, so the Nebraska Public Power District (NPPD) installed 38 high capacity (1,600 to 2,700 gallons per minute) wells in a 20-square mile area near the reservoir. These wells will extract water from the High Plains Aquifer and discharge to Sutherland Reservoir. NPPD project managers plan to utilize the well field starting in the summer of 2006, with a majority of the wells operating daily for up to four months, with similar pumping likely in the summers of 2007 and 2008, and if dry climatic conditions persist, beyond 2008. If necessary, the well field may be used for more than the currently planned four months each year. A number of management alternatives are available, including purposefully using the reservoir to recharge the aquifer in times of excess moisture. However the impact of the alternative scenarios on water levels in nearby wells and groundwater discharge to the South Platte River is not known. A representative groundwater model would be a useful management tool.

The subsurface hydrology is not well understood, so the U.S. Geological Survey USGS and NPPD plan a 3-year study to further characterize the aquifer and identify natural tracers of the reservoir seepage water. This study allows for new data to be incorporated in a model and for model analysis to provide guidance to the data that will be most valuable in reducing predictive uncertainty.

The proposed project develops an effective approach to characterization that focuses on reduction of the associated predictive uncertainty. In an iterative process, available data (of varying type) are integrated through modeling that yields predictions (and associated uncertainty) for evaluated management scenarios. Alternative algorithms for estimating the hydrostratigraphy will be implemented and evaluated. Model averaging allows multi-model inference on predictions and the associated uncertainty. Analysis of the models indicates the most valuable additional data (type, location, and time) that could be collected and this is incorporated into the field investigations. The resulting data are used to modify the initial set of alternative models. The evolving models facilitate evaluation of the impact of alternative management scenarios on water levels in wells and discharges to the South Platte River.